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ABSTRACT

The first report details the computer education plans of the school district in Palo Alto (California), where the use of the computer is part of normal school activities in grades K-6, all seventh grade students participate in a computer awareness unit, and students in grades 9-12 are encouraged to enroll for one quarter in a computer studies course. Elective courses are also offered for middle school and high school students. The second report describes the program in Los Angeles (California), where fifth grade students are introduced to computers through the use of the Logo programming language and word processing. Introductory courses are provided for both junior high/intermediate students and high school students as well as advanced level courses. A management plan for introducing computers into public schools is presented in the third report, which is based on a review of the literature and experience in implementing a computer program in the Keene (New Hampshire) district schools. This report also discusses six basic components of the implementation process. THe fourth report presents a tentative 8- to 10-year computer technology plan for the Cincinnati Country Day School in a chart which shows both past and future computer use in the school under the headings of hardware, software, staff development, curriculum, computer science, math, science, history/English, language, and music/art/dance. (EW)

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Computer Science Education
Palo Alto Unified School District

ED302178

IR013537

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Goal of Computer Science Education

The overall goal of the PAUSD educational plan is to infuse into the lives of the district's K–12 clients every computer-related experience possible. These experiences need to be consistent with the responsibilities of a modern school district and appropriate to the current and predictable needs of its students.

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Program Description

The Palo Alto computer science education program is intended for grades K–12.

In grades K–6, the use of the computer is a part of the normal school activities. Students receive direct instruction by the classroom teacher or other staff members and use available software to develop initial knowledge and skills, reinforce previous learnings, and enrich academic areas.

In the Middle School, all seventh grade students participate in a Computer Awareness Unit. Elective course offerings (Computer 11 and 12) include the use of simulations, data management, word processing, and spreadsheet software. Students are introduced to programming structure and techniques through LOGO and BASIC. In addition, the Computer Labs are available on a drop-in basis and for independent study and peer/computer tutoring. Finally, computers on carts are brought to the classrooms where students have the opportunity to use the software and/or develop programs related to classwork.

In grades 9–12 it is recommended that all students, unless a student demonstrates proficiency in computer studies or has passed an equivalent course prior to attending high school, enroll for one quarter in a Computer Studies course. Electives in programming languages, problem solving, and business education using the computer are offered.

Summer sessions, for students of all grade levels, offer exploration and in-depth instruction in computer applications and programming languages. For K–3, math exploration, problem-solving, and computer exploration using LOGO are available. At the middle elementary school level, 4–6, LOGO and BASIC are taught with an expanded program that includes word processing and math skills. High school sessions focus on BASIC and Pascal programming languages, graphics and plotters, keyboarding and word processing. SAT preparation software materials are available to students who are enrolled in the course for reinforcement and enrichment.

Elementary and Middle School Computer Curriculum

Computer Concepts

Integration of Computers into Daily Life	Social Effect of Computers in Silicon Valley	Historical Development of Computers	Logic	Vocabulary of Common Terms and Names	Future Development of Computers
Identify where computers are found in everyday life.	Identify relatives and neighbors who work in computer-related businesses. Identify the geographical area called Silicon Valley.	Identify some inventors and computing devices which were precursors of the microcomputer.	N/A	Recognize words describing computer parts and functions.	Identify the major contributions of computers to American culture. Identify possible broad scenarios for short-term, next developments.
Identify jobs and professions using computers and explain the use of computers in those fields.	Gain an awareness of the impact of the computer industry on everyday life.	Develop an understanding of the scope of the history of computing machines.	Use programs which require conclusions based on logical deduction. Use programs with instructions deleted so that the purpose of the exercise must be deduced.	Demonstrate fluency in using computer terms when describing hardware and software.	Apply simple futuristic conceptual thinking in developing both short- and long-term scenarios for the role of computers in the technology of the United States.
Project the future uses of computers and robotics.	Create a report (using a word processing program) on some aspect of the impact of Silicon Valley developments on the local society.	Describe the historical sequence of the inventors and inventions which preceded the "technological revolution."	Use standard flowchart symbols to show how a task is broken up into integral parts and movements before it becomes programmable. Create a computer program.	Express technical and programming ideas using the appropriate computer words.	Apply futuristic conceptual thinking for the development of computers in the future of mankind.

Computer Skills

K–3

Keyboard Use: Recognize location of letters and numerals. Understand use of special keys.

Use of Prepared Programs: Follow directions for working with different programs. Be able to use menu-driven disks.

Use of Hardware and Software: Use the computer and disk drive properly. Treat software in an ethical manner.

Identify Parts of the Computer: Name some of the parts of the computer and its peripheral equipment.

Programming: N/A

Read Manuals and Specifications: Follow simple directions from manuals to get a program started. Select programs from a menu.

Select Hardware and Software: N/A

4–6

Keyboard Use: Locate keys to input words. Demonstrate awareness of proper typing skills while at keyboard.

Use of Prepared Programs: Load and use programs from disks without menus. Create a graphics display using LOGO. Follow directions for working with applications programs.

Use of Hardware and Software: Alter and copy only those programs for which there is permission. Demonstrate proper use of the printer.

Identify Parts of the Computer: Identify and describe the use of some of the internal parts of the computer. Use the correct technical terms when describing the computer.

Programming: Explain the concept of programming. Develop a two-step program using LOGO or BASIC.

Read Manuals and Specifications: Follow reference manuals to use programs and all subroutines of the programs.

Select Hardware and Software: Identify the major factors in selection of hardware and software.

7–8

Keyboard Use: Create a report card using a word processing program.

Use of Prepared Programs: Use commands in programs to create original programs. Create a report using a word processing program.

Use of Hardware and Software: Respect the rights of users and programmers when sharing lab facilities.

Identify Parts of the Computer: N/A

Programming: Write programs using text and graphics to accomplish a specific task. Modify existing programs.

Read Manuals and Specifications:
Read and understand manuals with more complex specifications.

Select Hardware and Software
Consider pros and cons on selection of hardware and software.

Science Education Curriculum
Computer Concepts

Computer Science Education

K-3

Computer Skill: Use the keyboard.

Student Goal(s): To recognize the location of letters and numerals and understand the use of the special keys.
Experience(s): Routine classroom use of computer-assisted instruction
Software Materials: Introduction to the Keyboard MECC Vols. 1, 2, 4, 5, 7, 11, 12, Bumble's Puzzle, Gertrude's Secret, Moptown Hotel.
Supplemental Materials: Posters

Computer Skill: Use prepared programs.

Student Goal(s): To follow directions for working with different programs—simulations, drill exercises, and problem-solving. To demonstrate successful use of menu-driven disks, changing from program to program.
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Skill: Use of computer hardware and software.

Student Goal(s): To demonstrate, with minimal supervision, the ability to use the computer and disk drive properly. To treat software in an ethical manner (getting permission to copy a program). To handle software carefully and correctly.
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Skill: Identification of parts of the computer:

Student Goal(s): To name correctly some of the parts of the computer and its peripheral equipment and explain their use (keyboard, monitor, drive, diskette, computer, printer).
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Skill: Ability to read manuals and specifications.

Student Goal(s): To follow simple written and/or graphic directions from a manual or chart to get a program started.
Experience: Routine classroom use of computer-assisted instruction.

Computer Concept: Integration of computers into daily life.

Student Goal(s): To identify places where computers are found in everyday life (such as offices, department stores, grocery stores, restaurants, and banks).
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Concept: Social Effect of Computers in Silicon Valley

Student Goal(s): To identify relatives and neighbors who work in computer-related businesses (including research, manufacturing, marketing, telecommunications). To identify the geographical area called Silicon Valley.
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Skill: Historical development of computers.

Student Goal(s): To identify inventors and the computing devices which were precursors of the microcomputer.
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Concept: Vocabulary of Common Terms and Names

Student Goal(s): To recognize words describing computer parts and functions (such as computer, monitor, drive, software, load, boot up)
Experience(s): Routine classroom use of computer-assisted instruction

Computer Concept: Future Development of Computers:

Student Goal(s): To identify the major contribution of computers to American culture. To identify possible broad scenarios for short-term, next developments.
Experience(s): Routine classroom use of computer-assisted instruction.

4-6

Computer Skill: Keyboard Use

Student Goal(s): To locate keys to input words. To exhibit an awareness of proper typing skills while at the keyboard (that is, the importance of hand and finger placement in reaching keys)
Experience(s): Routine classroom use of computer-assisted instruction. Independent use of the computer. Exploration in typing.
Software Materials: Introduction to the Keyboard and Typing Tutor.
Supplemental Materials: Keyboard chart.

Computer Skill: Use of Prepared Programs

Student Goal(s):
To load and use programs from disks without menus, including DOS and utilities programs. To create a graphics display while using a program such as LOGO. To follow directions for working with application programs (such as word processing program).
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Skill: Use of Computer Hardware and Software

Student Goal(s): To alter and/or copy only those programs for which there is permission. To demonstrate proper use of the printer.
Experiences(s): Classroom demonstrations, Routine classroom use of computer-assisted instruction.

Computer Skill: Identification of Parts of the Computer

Student Goal(s): To identify and describe the functions of some of the internal parts of the computer (such as controller card, motherboard, circuit board, slots). To use the correct technical terms when describing the computer .
Experience(s): Visual and hands-on examination of the microcomputer. Routine classroom use of computer-assisted instruction.

Computer Skill: Programming

Student Goal(s): To explain the concept of programming (identifying a problem, figuring out the steps needed to solve the problem, coding the sequence of steps, reworking and correcting problems in a program). To develop a two-step program using LOGO or BASIC (a list of instructions that the computer carries out one at a time).
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Skill: Ability to Read Manuals and Specifications

Student Goal(s): To follow reference manuals (with minimal consultation) when using programs and all subroutines within programs.
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Skill: Ability to Select Hardware and Software

Student Goal(s): To identify the major factors that need to be considered when selecting computer equipment and software (identify primary users, intended use, price range, and so on)
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Concept: Integration of Computers into Daily Life

Student Goal(s): To identify jobs and professions using computers and explain the use of computers by workers in those fields (such as newspaper reporters, reporters, travel agents, farmers, office workers).
Experience(s): Visitors/guest speakers from the work world. Routine classroom use of computer-assisted instruction.

Computer Concept: Social Effect of Computers in Silicon Valley

Student Goal(s): To develop an understanding of the scope of the history of computing machines.
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Concept: Logic

Student Goal(s): To explain the basic operation of the sequence of events within a computer. To describe how information is processed. To use programs which require conclusions based on logical deductions. To use programs with instructions deleted so that the purpose of the exercise must be deduced.
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Concept: Vocabulary of Common Terms and Names

Student Goal(s): To demonstrate fluency in using computer terms when describing hardware and software (including chips, CPU, menu, catalog).
Experience(s): Routine classroom use of computer-assisted instruction.

Computer Concept: Future Development of Computers

Student Goal(s): To apply simple futuristic conceptual thinking in developing both short and long-term scenarios for the role of computers in the technology of the United States (such as electronic mail and banking, degree-day information in agriculture)
Experience(s): Routine classroom use of computer-assisted intruction.

7–8

Computer Skill: Keyboard Use

Student Goal(s): To create a report using a word processing program
Experience(s): Computer Awareness Unit, routine classroom use of computer-assisted intruction, Computer II, Independent Study, Typing.
Software Materials: AppleWriter II, Bank Street Writer, PFS Write.

Computer Skill: Use of Prepared Programs

Student Goal(s): To respect the rights of other users and programmers when sharing computer lab facilities (for example, sharing time at the computer, accessing and altering only your own programs from a group diskette).
Experience(s): Computer Awareness Unit, routine classroom use of computer-assisted intruction, Computer II, Independent Study.

Computer Skill: Programming

Student Goal(s): To create programs using text and graphics to accomplish a specific task.
Experience(s): To modify existing programs, Computer Awareness Unit, Computer II, Independent Study.

Computer Skill: Ability to Read Manuals and Specifications

Student Goal(s): To read and understand manuals and more complex specifications on computer programs and equipment.
Experience(s): Computer II, Independent Study.

Computer Skill: Ability to Select Hardware and Software

Student Goal(s): To consider the pros and cons on selection of hardware and software, including such factors as costs in relation to utility, and long-term value.
Experience(s): Computer II, Independent Study.

Computer Skill: Integration of Computers into Daily Life

Student Goal(s): To project the future uses of computer and robotics (that is, artificial intelligence, factory robots).
Experience(s): Computer Awareness Unit, Social Studies, Computer II, Independent Study.

Computer Concept: Social Effect of Computers in Silicon Valley

Student Goal(s): To create a report, using a word processing program, on some aspect of the impact of Silicon Valley developments on the local society.
Experience(s): Computer II, English, Social Studies, Independent Study.

Computer Concept: Historical Development of Computers

Student Goal(s): To describe the historical sequence of the inventors and inventions which preceded the "technological revolution" taking place in the late twentieth century.
Experience(s): Computer II, Social Studies, Independent Study

Computer Concept: Logic

Student Goal(s): To express technical and programming ideas using the appropriate vocabulary.
Experience(s): Computer II, Independent Study

Computer Concept: Vocabulary of Common Terms and Names

Student Goal(s): To express technical and programming ideas using the appropriate vocabulary.
Experience(s): Computer II, Independent Study.

Computer Concept: Future Development of Computers

Student Goal(s): To apply futuristic conceptual thinking for the development of computers in the future of mankind.
Experience(s): Social Studies, Computer Awareness Unit, Computer II, Independent Study

Extended/Independent Study

Extended/Independent Study is offered to Middle School students in several ways:
1. After negotiating a contract among the classroom teacher(s), parent(s), and student, students are released from class one or more periods weekly to explore computer programming and computer applications. The contract is usually for a length of approximately 8 sessions (8 weeks). A student tutor works with one or two students and instructs the learners in computer programming in BASIC.

2. Students meet individually or in small groups (6 to 8 students) during regularly scheduled class periods to receive instruction in word processing and/or computer applications relevant to the course of study.

3. While serving as teacher's aides, students assist other students and pursue individual interests in computer applications and programming.

4. Before and after school, students have the opportunity to work independently on class work and areas of interest.

Course Description

Course Title: Computer 12.
Department(s): Computer Science Division.
Course Length: 1 semester.
Grade Level(s): 7 and 8.
Recommended Preparation: Computer 11, Keyboarding highly recommended.
Instructional Goals: To extend and sharpen the student's programming skills. To learn about the wide variety of computer applications.
Course Content: Extension of programming techniques including
- Efficiency of programming
- File creation and manipulation
- High-resolution graphics
- Use of word processing
- Use of spreadsheet software
- Use of elementary data management software

Course Description

Course Title: Computer 11.
Department(s): Computer Science Division.
Course Length: 1 semester.
Grade Level(s): 7 and 8.
Recommended Preparation: Keyboarding highly recommended.
Instructional Goals: To communicate with the computer through programming languages. To recognize the value of the computer in problem solving. To learn about the wide variety of computer applications.
Course Content: Computer awareness, including such topics as history, uses, vocational and career opportunities, how computers work, and ethical issues in computer use.

Programming in LOGO
Primitive commands
Figures and designs
Debugging
Procedures
Editing
Saving to disk
Variable inputs

Problem Solving in LOGO
Debugging existing programs
Planning, creating, debugging original programs
Procedural thinking
Generalizing strategies
Predicting results

Programming in BASIC
Numeric and string variables
Exponential notation
Formatting
Order of precedence of operators
Subroutines
Data, variables, arrays
Statements
Counters and accumulators
Random number generators
Saving and editing programs
Loops and branching
Debugging

Low-resolution graphics
Commands
For-Next loops
Plotting
Combining graphics with text
Use of simulations for problem solving and exploration

Course Description

Course Title: Computer 12.
Department(s): Computer Science Division.
Course Length: 1 semester.
Grade Level(s): 7 and 8.
Recommended Preparation: Computer 11, Keyboarding highly recommended.
Instructional Goals: To extend and sharpen the student's programming skills, to learn about the wide variety of computer applications.

Course Content: Extension of programming techniques including:
Efficiency of programming
File creation and manipulation
High-resolution graphics
Use of word processing
Use of spreadsheet software
Use of elementary data mangement software

Computer Awareness Unit
7th Grade Science Students

Description: The Computer Awareness Unit is a one week mini-course presented by the Computer Education Coordinator and the Instructional Computer Services Specialist. Seventh grade science students and their teachers participate in the course, which is conducted in the Middle School Computer Lab.

Goals and Objectives:
1. To introduce all seventh grade students to the computer lab and encourage the use of the lab for all subjects and programming.
2. To expose students to present and future uses they might make of computers.
3. To introduce students to word processing, graphics and LOGO.
4. To reduce bewilderment and fear of current technology and promote a balanced view of the computer's role in society.

Computer Awareness Curriculum:
First day—historical development of computers, uses of computers in society, introduction to the keyboard.
Second day —introduction to BASIC.
Third day—introduction to LOGO and Graphics.
Fourth day—introduction to word processing and educational Software.

High School Course Offerings

Title	Department	Length/Credit	Grades	Preparation	Content
Computer Studies.	Computer Science.	1 quarter/2.5 units.	9–12.	Keyboarding.	Computer awareness, introduction to language, software, simulations, word processing, spreadsheet.
Typing/Keyboarding word processing.	Business Education.	1–4 semesters/ variable.	9-12.	None.	Develop skill in typing rapidly and accurately at both the typewriter and computer, tabulations, business letters, footnotes, grammar, and punctuation.
Computer-Assisited Accounting.	Business Education.	Year/5–21 units.	9–12.	Basic arithmetic skills.	Complete accounting cycle using double-entry system, accounting computer program used upon completion of basic theory. Spreadsheet.
Beginning Programming.	Computer Science Division.	1 semester/5 units.	9–12.	Computer Studies, Keyboarding.	Beginning skills of programming in Basic or Pascal, flowcharting, program design.
Computer Math.	Mathematics.	1 semester/5 units.	10–11–12.	Algebra, Beginning Programming, Keyboarding.	Math problems from algebra, geometry, trigonometry, calculus and statistics, programming in Advanced BASIC and PASCAL.
PASCAL Programming.	Computer Science Division.	1 semester/5 units.	10–11–12.	One year algebra.	Computer awareness, introroduction to language, software, simulations, word processing, spreadsheet.
Computer Science AP.	Computer Science Division.	Year/10 units 11, 12.	11–12.	Math 2II or 3A.	See advanced placement computer science outline, structured programming in PASCAL, files, data types, sorting, searching, and other algorithms.
Independent Study.	Computer Science Division.	Variable/contract.	9–12.	None.	Study and preparation for advanced placement, more advanced programming language study.

Skills Applications

Subject	Use
Science.	Predictions, calculations, simulations.
Social Studies.	Simulations, word processing.
Math.	Drill and practice reinforcement, calculations, Problemsolving.
English.	Vocabulary, grammar, word processing.
Business Education.	Data/word processing.
Art.	Line drawing, graphics.
Music.	Composition theory, note drill.
Practical Arts.	Typing skills, design, angles.
Home Economics.	Metric measurement, nutrition.
Foreign Language.	Vocabulary, culture, grammar, linguistic patterns.
Reading Lab.	SAT preparation, reading.
Computer Lab.	Drill and Practice programming, exploration, word processing, reinforcement.

Course Title: Typing/Keyboarding/Word Processing (Computer–Typewriter).
Department(s): Business Education.
Course Length: 1 to 4 semesters.
Credits: Variable to 20.
Grade Level(s): 9, 10, 11, 12.
Recommended Preparation: None.
Prerequisites: Previous development of skills will determine placement.

Four semesters of typing are available. Variable credit is given. Students will be placed within the program according to their competence. Completion of the program should lead to sufficient proficiency for personal and career expectations.

Instructional Goals
Keyboarding (all students):
1. To gain rhythmic stroking of the keyboard, using designated fingers with correct positioning of body, arms, hands, and fingers, so they can relax and realize their ultimate potential.

2. To develop quick finger response to copy they are reading by typing patterns, phrases, sentences, and paragraphs having similar letter patterns; then progressing to more difficult copy.

Word Processing:
3. To learn to center copy of varying lengths, to tabulate, write business and personal letters properly positioned on the page, and to type manuscripts with footnotes. Students will work from arranged and unarranged copy.

4. To type at an average of 30 to 40 gross words a minute with no more than one error per minute on three- to five-minute timings.

5. To provide students with sufficient experience in typing for personal use and at the same time provide a basis for career use.

Advanced Skills:
6. Definitely vocational in nature. Stress is placed upon production typing of representative business problems. Skill is developed in turning out error-free work. Students will learn to use the microcomputer to edit text. Most work will be done from unarranged rough drafts.

Students will use both the microcomputer and the typewriter at all levels of proficiency. The greatest emphasis will be placed on computer usage.

1. To develop skillful techniques in typing rapidly and accurately, using the touch system methodically with efficient work habits. To develop mastery of the keyboard and a working knowledge of all needed operative parts of the typewriter and microcomputer.

2. To develop skill in vertical and horizontal methods of centering columnar reports and typewritten copy on paper of varying sizes.

3. To develop adeptness in positioning and typing envelopes, well-centered letters, business forms, and manuscripts with footnotes.

4. To complement punctuation and grammar rules, stress work division, gain improvement in spelling, and expand the typist's vocabulary.

5. To develop speed and accuracy in taking timed writings.

Course Description

Course Title: Computer-assited Accounting.
Department(s): Business Education.
Course Length: Year.
Credits: 10 (variable).
Grade Level(s): 9, 10, 11, 12.
Recommended Preparation: Basic arithmetic skills.
Instructional Goals: To acquaint students with a systematic method of setting up and keeping financial records for business or personal use.
To prepare students for entry-level positions in the business community.
To prepare students for future accounting classes in college.
To make students computer literate in the general field of accounting.
Course Content: A double-entry system of accounting is used.

This course covers the complete accounting cycle emphasizing good work habits, neatness, and accuracy.

The student will first learn a systematic method for making journal entries, posting to ledgers, preparing trial balances, preparing financial statements, and adjusting and closing books. Students will use practical workbooks, worksheets, and other business forms such as invoices, bank deposit slips, checks, credit memoranda, and cash receipts. The computer will be used to facilitate the processing of this data.

Computer Application: Accounting applications on the computer will begin with the trial balance, income statement and balance sheet. Spreadsheet may be used for some portions of the accounting program. A full-scale accounting computer program will be used upon completion of basic accounting theory. Report writing using the microcomputer will be included for advanced-level students.

Course Description

Course Title: Beginning Programming.
Department(s): Computer Science Division.
Course Length: 1 semester.
Credits: 5 units.
Grade Level(s): 9, 10, 11, 12.
Recommended Preparation: Computer Studies or equivalent, Keyboarding highly recommended.
Instructional Goals: To teach the student the beginning skills of computer programming, to have students debug and run their programs on a computer.
Course Content:
Simple flowcharting
Design of a computer program
Language structure and use, such as BASIC, or Pascal
Numeric and string variables
Mathematical operations
Statements
Functions, formatting, subroutines
Looping
Disk operation
Loading, running and saving programs
Output devices

Course Description:

Course Title: Computer Mathematics.
Course Length: 1 semester.
Credits: 5 units.
Grade Level(s): 10, 11, 12.
Recommended: One year of algebra, one year of geometry, beginning programming or equivalent, keyboarding.
Instructional Goals: To extend and sharpen the student's programming skills as well as mastering the computer as a tool to solve problems of a mathematical nature.
Course Content: Use of computer to solve mathematical problems chosen from advanced algebra, geometry, trigonometry, calculus, and statistics. Programming in advanced BASIC and/or Pascal.

Course Description:

Course Title: Pascal Programming.
Department(s): Computer Science Division.
Course Length: 1 semester.
Credits: 5 units.
Grade Level(s): 10, 11, 12.
Recommended Preparation: One year of algebra, one year of geometry, beginning programming or equivalent, keyboarding.
Instructional Goals: To extend and sharpen the student's programmimg skills, to include sufficient programming skills for those students who wish to pursue later the requirements of the Advanced Placement curriculum in Computer Science.
Course Content:
Extension of programming techniques including:
Experience in structured programming
Efficiency of programming
File creation and manipulation
Merging of programs
Sorting and other algorithms
Programming in Pascal
Graphics

Course Description:

Course Title: Computer Science AP.
Department(s): Computer Science Division.
Course Length: 1 year.
Credits: 10 units.
Grade Level(s): 11, 12.
Recommended Preparation: Completion of Math 2H, 3A, or above or department approval. Some familiarity with computers/programming is suggested.
Instructional Goals: To provide the student with a course equivalent to the first course in Computer Science at the college level.
Course Content: To follow the outline of the Advanced Placement Computer Science curriculum: designing structured programs using "top-down" and "stepwise refinement" methodically; translating the solution of problems into clearly written programs in Pascal; the study of data types and structures; searching and sorting techniques; the study of algorithms.

Computer Education Foundation Program
Los Angeles Unified School District
Office of Instruction

I. Introduction

A. The Computer Education Foundation Program for the Los Angeles Unified School District is an extension of the superintendent's position statement regarding computer literacy and the use of computers in instruction. It is based upon the recommendations of Computer Literacy and the Use of Microcomputers in Instruction by Dr. Robert Baker and Dr. James Taylor, presented to the Los Angeles Unified School District Board of Education on August 16, 1984. Computer literacy is defined in that document as having four dimensions:

1. First, there is computer awareness, the understanding of the existence of computers in our society, the use of computers, and the impact of their use upon our daily lives.

2. Second is the dimension of computer knowledge, characterized by comprehension of the history of computers, the evolution of the "generations" of computers, some knowledge of how computers work, and some limited skills in operating a computer.

3. The third dimension is computer competency, which includes expanded skills in computer education, some ability to manage the computer's functions through mastery of one or more computer languages, and a fuller understanding of the capabilities of the computer as a problem-solving tool.

4. The highest dimension of our definition of computer literacy, the fourth dimension, is computer expertise. This expertise can involve those technical skills needed to build and maintain the computer itself, or may focus entirely upon the highly sophisticated skills required to master the tremendous potential of this tool for the expansion of humankind's reservoir of knowledge.

B. Based on these four dimensions, the Baker-Taylor report developed a broad plan of action for a Districtwide computer-supported program. The Computer Education Foundation Program is an implementation plan supported by the recommendations of this report.

This program incorporates the district's Computer Literacy Continuum as well as the goal of integrating the computer, as an instructional tool, into the existing curriculum.

C. The Foundation Program includes the third dimension of computer literacy in the elementary school by teaching the programming language Logo in the fifth grade. It is expected that every student will have access to the Foundation Program in the secondary schools. The program also provides for a grass-roots, in-service training plan by using teachers and coordinators with computer expertise as instructors for targeted staff members who will be directly involved in implementing the program at the school sites.

II. Program Specifications

A. Program Goals

• To achieve student computer literacy and to expand the utilization of microcomputer technology as an instructional support tool in the schools of the Los Angeles Unified School District.

• To provide students with equal access to:
1. Computer hardware.
2. Instruction in computer science.

B. Program Objectives

• All schools, over a three-year period, will participate in an instructional program designed to provide computer literacy instruction for all students.

• All participating students will benefit from the instructional use of computers.

• The Foundation Program will complement the district's instructional guidelines and courses.

Elementary Program

The computer program at the elementary school level will be integrated into the existing Los Angeles Unified School District's curriculum. The program will begin in the fifth grade.

• Logo and word processing will be the emphasis of student instruction. Logo's graphics provide a visual outcome of ideas and experiments by children. Logo provides an environment for the application of many of the curriculum skills identified in the fourth and fifth grade continuum. Logo's editing features provide for the rudiments of word processing. Logo's programming structure provides a problem-solving strategy that can be written in outline form rather than in symbolic flowcharts. Logo may encourage children's critical thinking, assist in the acquisition of basic educational skills, and increase enthusiasm and motivation for learning by providing immediate feedback.

• The elementary program will include the integration of computers into as many subject areas as possible.

• The Foundation Program will also support the instructional program by teaching:
1. Keyboarding skills and use of computer peripherals
2. Skills identified in the Computer Literacy Continuum
3. Visual experiences that enhance the understanding of spatial relationships
4. Problem-solving strategies through writing computer procedures in sequential steps
5. Experience in proofreading, editing, refining, and redesigning computer procedures

• Students will be provided with an opportunity to enrich their studies through participation in after-school computer clubs.

Secondary Program
The program at the secondary level will be derived from the Continuum of Skills. Specific courses are outlined in the District's Guidelines for Instruction, Secondary School Curriculum, 1984 edition.

Junior High/Intermediate Program
- Introduction to Computers (10–week course)—18–01–01
- Introduction to Computers (20–week course)—18–01–03

The decision to offer either a 10-week or a 20-week course is a school programming option.

- Opportunities for expanding skills in computer science beyond the Foundation Program may be fulfilled by the following courses:

1. Computer Programming 1AB 18–02–01, 18–02–02 Annual Course
2. Computer Programming 2AB 18–02–03, 18–02–04 Annual Course
3. Digital Computer Technology 1AB 18–07–01, 18–07–02 Annual Course
4. Information Processing 18–05–01 Semester Course

- Departments should explore opportunities for integration into the existing instructional program.

Instructional guides are available for Introduction to Computers as follows:

10–week course: Publication No. SC–857, 1984, Office of Secondary Instruction
20–week course: Publication No. SC–858, 1984, Office of Secondary Instruction

Senior High Program
- Computer literacy instruction will be offered to all students who have not previously had an opportunity to take such instruction (by school option either the 10–week or 20–week course).

- The high school program should include courses that will build students' expertise in the area of computer science.

These courses should include:

1. Computer Programming 1AB	18–02–01, 18–02–02
2. Computer Programming 2AB	18–02–03, 18–02–04
3. Computer Programming 3AB	18–02–05, 18–02–06
4. AP Computer Science AB	18–02–07, 18–02–08
5. Word Processing	18–04–01
6. Data processing	18–03–01
7. Information Processing	18–05–01
8. Digital Computer Technology 1AB	18–07–01, 18–07–02
9. Digital Computer Technology 2AB	18–07–21, 18–07–22
10. Digital Computer Technology 3AB	18–07–31, 18–07–32

• During the summer, opportunities for acquiring computer competency and expertise will be offered at selected high schools for all students.

• The high school program will include application of computers in as many subjects as possible. The school will be responsible for developing a plan that will assure the use of computers in various subject areas. This school plan should include department meetings and in-service training so as to integrate computer usage as effectively as possible.

Course descriptions and representative objectives are found in Guidelines for Instruction: Computer Science, Publication No. SC-

C. Hardware Requirements

• One computer for each fifth grade class (complete with monitor, information retrieval, and memory sufficient to support software). Thirty microcomputers for each secondary school (complete with monitors, dual disk drives, and memory sufficient to support instructional software—must have 64K minimum).

• Printers will be allocated as follows:

1. Elementary—one printer per school or two for more than five computer stations
2. Secondary—five printers per school

• Computer laboratories should be set up to meet instructional objectives

• Funds have been allocated for alterations and improvement (for example, security and electrical) of computer laboratories

D. Software Requirements

• The District will provide specific software as part of the Foundation Program. District in-service training will include the use and application of this software. All departments should have the opportunity to become aware of it and use it.

• Local schools will have the opportunity to purchase software than meets student needs. A specific amount of money will be allocated for this purpose.

• Each school will be provided with a foundation software package consisting of the following:

1. Elementary—Logo and word processing.

2. Secondary—data base, word processing, spreadsheets, BASIC, Pascal. (Pascal will be provided to senior high schools only.)

E. Demonstration Grants

• The demonstration grants will seek to encourage innovative use of the microcomputer as a classroom instructional resource. They will provide a means by which creative teachers, interested in computer utilization in instruction, may develop new uses of this support resource. The objective during the first year is to encourage use of the microcomputer in the fields not generally associated with computer activity.

• Proposals during the initial year of funding would be limited to the areas of English and Social Studies.

• It should be understood that grants are model applications that the district hopes to see replicated in other schools.

F. Evaluation and Monitoring

• During year one, the evaluation activities will necessarily emphasize the careful monitoring and modification of program implementation procedures. The successful installation of the program, consistent with the program's goals, objectives, and specifications, is of paramount importance if program outcomes are to be achieved.

The District Task Force will develop a plan and framework to assess the effectiveness (self-correcting when necessary) of prespecified activities related to:

1. Task Force functions
2. School selection and orientation
3. Staff training and development
4. Hardware procurement and school installation
5. Instructional software information, access, and development
6. Dissemination of information to parents and community

During the first year, instrumentation will be developed and verified that is sensitive to performance on program outcome indicators.

Four general program outcome areas have been identified as important:

1. Student skills proficiencies
2. Student motivation and productivity
3. Teacher productivity
4. Curricular efficiency

Progress reports will be submitted to the superintendent twice a year.

III. Program Implementation

A. Selection of Schools

• A three-year phase-in: It is suggested that the District's Foundation program be installed in all elementary, junior high, and senior high schools over a three year-period.

• School year 1984–85: Fifteen elementary schools and three junior high intermediate schools from each region should be selected by the region superintendent to begin Foundation Program implementation. In selecting schools, priority consideration shall be given to the following: school staff's willingness to volunteer for participation; Chapter I, PHBAO and year-round schools; schools with existing hardware below foundation program level; and grade level continuity between elementary and secondary.

Each successive year the junior high/intermediate schools would likewise be selected to conform to the elementary feeder schools that enter the program.

• In consultation with the Office of Instruction and appropriate region superintendents, the Senior High Schools Division superintendent will select 16 regular senior high schools for installations during 1984–85. Again, priorities should be given to volunteers requesting participation in the first year activity. The schools selected should represent both those that have developed some computer sophistication and those that have not. Selection consideration should be given to providing progressive continuity for junior high and intermediate school students who have participated in the program.

• School year 1985–86: Approximately 15 to 20 additional elementary schools and approximately three additional junior high/intermediate schools from each region will be selected by the region superintendent to begin Foundation Program implementation in 1985–86. School principals should volunteer for participation. In a similar manner, additional regular senior high schools will be selected for program implementation in 1985–86.

School year 1986–87: All remaining elementary, junior high/intermediate, and regular senior high schools will commence foundation program implementation.

Microcomputers in the Public Schools

A Management Plan

H. Charles Larracey
March 1986

Based on an extensive review of the literature, this writer has concluded that the essential components of a plan to introduce computers into the public schools include: (1) planning for organization and implementation; (2) curriculum development; (3) staff training; (4) acquisition of hardware and software; and (5) provisions for support services. School leadership personnel must effectively address each of these variable components in order to provide the opportunity for the computer to become a viable tool for both instructional and administrative applications. The computer, unlike other technologies that have been introduced and subsequently rejected, has the potential to improve the teaching and learning process; it has the potential to facilitate learning in the classroom. The computer presents a powerful opportunity for change in public school organizations.

The first part of this paper will outline the direct practical experience that this writer has had in introducing computer technology into the public schools. The second part will outline the essential experiences and review the literature.

Background Information

For the last four years this writer has directed an effort to introduce microcomputers into the seven schools of the Keene (N.H.) School District. Prior to that time the school district management personnel at both the central office and secondary levels did have access to a mainframe computer located at the central office and used exclusively for administrative applications. This school district has an enrollment of 4,100 students with an annual operating budget for the fiscal year 1985–1986 of $14,891,000.

The Keene School District has undertaken a number of initiatives pertaining to the introduction of computers into the schools. These computers have been used in three ways: (1) as an object of study K–12; (2) as an instructional tool in the various content areas; and (3) to improve the productivity and efficiency of teachers and managerial personnel.

The initiatives that have been undertaken include:

- The development of a comprehensive plan for K–12 computer education.

- The development of a K–12 Computer Science Skills Continuum, initially written in 1983 and revised in 1985. The continuum will be rewritten in 1987.

- The purchase of more than 270 microcomputers which are now available for use by instructional staff and students K–12. This represents a student-to-computer ratio of 15:1.

- The development of a centralized process for the evaluation; purchase, cataloging, storage, and distribution of computer software.

- The development of a staff training program designed to address all levels of ability and interest pertaining to the use of the computer in the educational process.

- Direct access to the central office mainframe computer (Digital PD11/44) by the seven schools of the district for automation of student management information, budget development, and other administrative applications.

• Access to software programs for the microcomputer used to computerize the development and revision of the individualized education plans for special education students.

• The employment of a Manager of Instructional Resources and Technology responsible for the coordination of all aspects of the K–12 computer education program (August 1985).

• The establishment of a loan policy for home use of microcomputers by instructional staff during school vacations and summer recess.

• The development of a professional library on the use of computers in education.

• The design and construction of microcomputer laboratories at Franklin Elementary School, Keene Junior High School, and Keene High School.

• The acquisition of a Digital VAX 11/750 minicomputer with more than 40 on-line terminals for instructional use at Keene High School.

• The development and implementation of a number of elective course opportunities for students at Keene High School/Cheshire Vocational Center, and Keene Junior High School (grades 7 and 8).

• Participation by professional staff in numerous national, regional, and state workshops on the use of computers in education.

• The development of a plan that enables school staff to purchase computers and related equipment via payroll deduction.

The Management Plan

This paper will now examine the important elements of the six basic components of a management plan for introducing computer tech. ology into the public schools.

A. Planning for Organization and Implementation

- The central office administration must present a vision for the organization and implementation of computer education for the district.

- A comprehensive plan for computer education should be developed for the school district.

- The plan should articulate a clear philosophical statement on the use of computers in the schools.

- The development of the plan should involve the active participation of all levels of the organization.

- The individual schools should develop a plan that is keyed to the overall district plan.

- A K–12 Computer Education Committee should be appointed to oversee all aspects of computer education for the district and for the individual schools.

- All plans for computer education should be reviewed and revised annually.

- The first step in the development of a plan is to conduct an assessment to determine the extent to which computer hardware and software is currently being used for instructional and administrative applications. The assessment could also be used to identify the type of training programs that personnel in the district have participated in.

- The plan should provide the opportunity for experimentation to occur in the various schools, for example, to determine the best location of computers.

- The plan should attempt to define what computer literacy means; for the student, for the teacher, and for the school administration.

- Once a certain critical mass has been reached, a K–12 coordinator for the program should be appointed.

- The members of the Board of Education must be kept informed of all aspects of the plan. Their continuous support is essential.

- Individual schools should formulate guidelines for student use of microcomputers (covering operating instructions, minimum proficiency requirements, time schedules, and so on). Some schools may award computer operator licenses to students once they have demonstrated a standard of proficiency.

- A set of specifications for the design of microcomputer laboratories should be developed.

- The school library/media centers are an integral (if not central) part of an effective computer education plan.

• The district plan should outline the variety of ways that the computer could be used for instructional and administrative purposes: (such as word processing, test construction, library circulation, accounting, gradebooks, attendance, and classroom demonstrations.)

• Long-range plans should be developed on a 2- to 3-year basis, rather than for a longer duration, because of the rapid rate of technological developments.

B. Curriculum Development

• The school district should develop a K–12 skills continuum for computer science instruction (a skills continuum indentifies the skills to be taught at each grade level).

• The skills continuum should be rewritten every two (2) years in order to maintain pace with technological developments.

• The four key sections of a computer science continuum include computer awareness, computer operations, computer-assisted instruction, and computer prgramming.

• Programs in the elementary schools should not emphasize computer programming.

• The plan for teaching keyboarding skills should be formulated and implemented in the elementary schools.

• Close cooperation among staff in the elementary, junior high, and high school is essential and is key to effective program development and coordination.

• The responsibility for computer science instruction should not be automatically assigned to the mathematics department.

C. Staff Training

• Training programs should initially involve school personnel who are interested in utilizing the computer for instructional or administrative purposes.

• Training programs should address the issues of computerphobia or technophobia.

• Trainers need to be senstive to teacher's and administrator's emotional reactions to the computer and structure the training in a nonthreatening manner.

• Workshops for teachers should concentrate on the use of tools programs, word processors, data bases, spreadsheets, graphic utilities, and the like.

• A training model should include continuous and on-site support for neophyte teachers.

• The training should be practical; it should provide the opportunity for hands-on experience.

• A school district should identify its own system "experts" to run training programs and to be available for follow-up questions or problems.

• The training programs should allow for experimentation and creativity.

• The training programs should promote a positive attitude of working together, of expecting to need help, and of seeking help.

• Training programs for teachers should include such topics as: the advantages and disadvantages of using the computer in the instructional process; the compatibility between doing tasks by computer and using traditional methods; a survey of computer applications in the classroom; the historical development of the computer; understanding the impact the computer can have on the teaching process; and insight into the major problems involved in the integration of computers into education.

• Teacher training programs should not generally emphasize acquisition of programming skills.

• Training programs should provide informal opportunities for personnel to share information.

D. Acquisition of Hardware and Software

• Criteria for the selection of software should be clearly deliniated. Such criteria should include: documentation, instructional objectives, learning objectives, accuracy of content, validation, compatibility to software offered by other vendors, operating costs, copyright, and so on.

• Criteria for the selection of hardware should be clearly identified. Such criteria should include: warranty information, maintenance costs, availability of software, peripherals, vendor assistance, documentation, amount of sales to other districts, training, installation of equipment, and the like.

• The selection of software for computer-assisted instruction should be related to the skills to be taught at the various grade levels and in the K–12 content areas.

• Standardization of equipment allows for an exchange of software among schools and promotes the most effective maintenance arrangements.

• The software should be previewed and evaluated prior to making a decision to purchase.

• A software catalog should be developed at the district level for dissemination to all classroom teachers. This catalog should include a brief description of the software, a rating of the software, and the appropriate grade level for use.

E. Provisions for Support Services

• A professional library of resource information should be created.

• A centralized system for preview, evaluation, purchase, storage, and distribution of computer software should be established.

• A process for the dissemination of information should be established. It is impossible for any one person to devote the time required to keep up with the developments in computers and other technologies.

• Support and encouragement should be provided for the formation of user groups in the local areas.

• A preventative maintenance program should be instituted for all computer and peripheral equipment.

• The school district should develop specific guidelines on copyright information.

• School personnel should be encouraged to participate in local, regional, state, and national conferences on computers in education.

F. Program Evaluation

An essential component of the management plan is a system for continuous evaluation. An evaluation plan should initially focus on such factors as (1) effectiveness of in-service training, in particular, the type of training which seems to be the most effective in empowering the classroom teacher to utilize the microcomputer; (2) the percentage of staff participation in training programs; (3) an assessment of both the availability and utilization of computer hardware and software; (4) a review of the school district's management plan for the introduction to computers in the schools for both administrative and instructional purposes. After a period of 3 to 4 years the evaluation plan should focus on student learning outcomes.

The formative evaluation plan will provide continuous feedback on all aspects of the management plan so that adjustments can readily be made to improve the strategies and approaches utilized in the various schools. The primary objectives of this evaluation component are to provide continuous in-process feedback; to discover unplanned and unexpected consequences that are resulting from particular program practices; to suggest realistic alternative courses of action for program modification; to determine the underlying policies and administrative procedures that contribute to the success or failure of particular components of the plan; and finally, to determine whether or how effectively the objectives of the program are being fulfilled.

All programs need to be evaluated over time in order to gather information on which to base conclusions and make recommendations for change. The ultimate question to be answered is to what extent has the application and utilization of computers interacted with the teaching process to improve student learning.

Computers in the Schools

A Management Plan

DESCRIPTION	1	2	3	4	1	2	3	4	1	2	3	4
Needs assessment: analysis of current use and projection of futute use/needs.	●	●										
Selection of K-12 Computer Education Committee.		●	●									
Selection of hardware, development of bid specifications, and selection of vendor.				●	●							
Development of comprehensive computer education plan.			●	●								
Evaluation of software, preview, purchase, storage, cataloging and distribution.				●	●	●	●	●	●	●	●	●
Development of K-12 Computer Science Skills Continum.							●	●				
Appoint district K-12 Computer Education Coordinator.									●			
Training programs for teachers and administrators.			●	●	●	●	●	●	●	●	●	●

Summary

It is this writer's opinion that the most important single element in the successful introduction of computers into the public schools is the classroom teacher. School district leadership personnel must focus on this important person and develop a staff training program that will address the concerns of classroom teachers about this innovation.

To incorporate any new program into an organization successfully requires an effective blending of leadership skills, an appreciation and sensitivity to the process of change, and a knowledge of the elements of the program itself. This careful blending must occur if the program is to become an inherent part of the organization.

Computers in the Schools
A Management Plan

Description

1. Needs assessment: analysis of current use and projection of future use/needs.
2. Selection of K–12 Computer Education Committee.
3. Selection of hardware, development of bid specifications, and selection of vendor.
4. Development of comprehensive computer education plan.
5. Evaluation of software, preview, purchase, storage, cataloging, and distribution.
6. Development of K–12 Computer Science Skills Continuum.
7. Appoint district K–12 Computer Education Coordinator.
8. Training programs for teachers and administrators.

"Do's and Don'ts" of a Computer Education Management Plan:

1. Do remember that the computer is an instructional tool; it is not the instructional tool.
2. Do not force teachers to use the computer as an instructional tool.
3. Do start the plan initially with those teachers who are interested.
4. Teachers on staff are the best resources for trainers in staff development.
5. Do not allow individual schools to go off on their own; a district level framework is essential.
6. Do allow an option on the location of computers in the school; for example, individual classrooms, computer laboratory, or library/media center.
7. The interest and involvement of central office administration will be essential to the success of a computer education plan.
8. Do offer programs for parents in the evening, open houses during the school day or during school vacations.
9. Do keep the school board/committee informed of all activites. Their continued support is essential.
10. Do allow the teachers to experiment; do allow the opportunity for creativity.
11. Do not purchase software without providing the opportunity for previewing and evaluation by at least 3 or 4 classroom teachers.
12. Do standardize equipment purchases, particularly during the early stages of implementing a computer education plan.
13. Do not assume that all teachers will be equally motivated or interested.
14. Do centralize the purchasing of hardware or software. Most companies offer substantial discounts for bulk purchasing.
15. Do not purchase a maintenance contract for all pieces of equipment; the hardware is remarkably trouble free.
16. Do install a security alarm system for all computer laboratories.
17. Do not install carpeting or allow the use of chalk-boards in computer laboratories.
18. Skills in programming the computer should not be emphasized in staff development program.
19. Do remember that computers present a powerful opportunity for change in school organizations.
20. Do remember that change is a process; not an event.
21. Do incorporate in the management plan a public relations component involving the local media. It is essential to keep the community informed.
22. Do allow the use of computer laboratories for evening adult education programs.

School Level Plans

Technology Plan

Cincinnati Country Day School
Cincinnati, Ohio

This document is a tentative technology plan for the next eight to ten years at Cincinnati Country Day School. We are fully aware that because of rapid changes in technology, revisions to this plan may be necessary and desirable.

Throughout the plan the following abbreviations are used: US—Upper School, grades 9—12; LS—Lower School, grades pre—Kindergarten to 5; MS—Middle School, grades 6—8; WP—Word Processing; DB—Data Base.

In the Computer Science column, the breakup reflects the fact that computer development was handled by the Physics department until 1980, by the Math department from 1980 to 1982, and after 1982, as a separate department.

In subject-area columns, the asterisks represent estimates of the amount of computer usage in that particular discipline at the time.

Now moving into its fourth generation of computer hardware, Cincinnati Country Day School is firmly committed to remaining a leader in computer education. Though we intend to support our aging Apple II family as long and as richly as possible, our future clearly belongs with the Macintosh. We have been involved with Macintoshes for two years, and fully expect all academic areas (not just math and science) to make optimum use of this new user-friendly environment to enrich their disciplines.

	Hardware	Software	Staff Development	Curriculum	Computer Science	Math	Science	History English	Language	Music Art Drama
1970	2 Terminals, Outside Host	Inhouse Developed Science Oriented	Computer Developed Director Named (David E. Laird)	BASIC & Fortran Independent		■	■■■			
				Astronomy & Physics Projects		■■	Projects ■■■■■			
			Inservice Courses				Interfacing			
1975	HP 2000 inhouse 16 Terminals on Campus Time Share Host	Inhouse HP Canned	Text in BASIC			■■	■■■■■■■			
						■■	■■■■■■■			
						■■				
			Memorial Lard Funds Supports Hardware Staff Curriculum Development	Middle School Requiremdnt BASIC Course (1982)					■	
1980	6 Apples 3 Pets 17 Apples Classroom Big Screening Computer Lab 300 Baud Modem	$5K/year Commercial Apple The Source Compuserve Dow Jones				■■■ ■■■ ■■■	■■■■■■■	Word Processing	■	
					1983			■		
	Lower School Apples 37 Apple Total 5 Macintoshes (1984)	Beta Test Sites MacPascal Macintosh Basic	Subbatical Program Turnido-Degree Teacher Apple Purchases Inservice Programs Summer Projects Courses Intern Programs	Electronic Bullitin Board	Computer Department Formed Keyboarding Lower School Logo Grade 4 BASIC Middle School	■■ ■■ ■■	■ ■■ ■■■	■ ■■	■	
1985	Applelink Account Word Processing Lab In Upper Schools Online Search Capabilities	Partnerships with Software Companies In Development	Salaried .5 Technician Salaried .5 Lower School Coordinator Word Processing Lab	Computer Required Keyboard Requirements Lower School English Department Word Processing	BASIC 1&2 Upper School Pascal APCS (84) Assembly	■■■ ■■■ ■■■■ ■■■■■	■■■ ■■■■ Interfacing ■■■■ ■■■■■■■ Lab Stations	■■■ Electronic Bullitin Board ■■■■■■■ ■■■■■■■ Word Processing Lab ■■■■■■ Data Base Work	■■■■ ■■■■	■■■■■■■ Theatergames ■■■■■■■ Mac Paint Course ■■■■■■■■ Art Stations Synthesizer
1990	20 Mac Pluses in Upper School MacLab, FileServer, HDisk Laserwriter Applelab, network,HDisk Lower School Lab (25 Macs) Lower School Word Processing & Keyboard Lab Classroom Demo Stations Satellite Hookup, Classroom Connection		Salaried .5 Manager Full Salaried Technician Degreed Department Head	History Department Data Base Continuing Education by Modem	Lisp	■■■■■■■■ Classroom Stations ■■■■■■■■ ■■■■■■■■ ■■■■■■■■ ■■■■■■■■ ■■■■■■■■	■■■■■■■■ ■■■■■■■■ ■■■■■■■■ ■■■■■■■■ ■■■■■■■■	■■■■■■■ Reading Progrms Required Research Papers Classroom Stations	Voice Programs ■■■■■■■■ ■■■■■■■■	■■■■■■■ ■■■■■■■ Hi Resolution Color Art Stations ■■■■■■■

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